which was with difficulty excluded from the interior of houses. Their duration varied from a few hours to two days; and from the fact that one of the dust-winds was simultaneously experienced at Hankow, Kiukiang, and Chinkiang—a portion of the river's course nearly equal to 450 miles—I may conclude that they were not local phenomena, but possessed a considerable horizontal extension. The dust, which in all respects resembles the loam forming the banks and alluvial plains of the Yang-tse, is composed of mineral particles and vegetable *débris* —the former varying from $\frac{1}{500}$ to $\frac{1}{1000}$ of an inch in size, and being generally siliceous or calcareous in composition.

Three dust-winds came under my observation on March 25, April 21, and May 1; all of them possessed the following meteorological conditions:—During the two or three preceding days the barometer fell, whilst the mean daily temperature rose, and in two instances the winds were light and southerly. During the continuance of the dust-winds the barometer rose, the mean daily temperature ceased to rise, and light winds with a force of 1 and 2 prevailed varying in direction from north to north-east. For a period of a day or two after the dust-winds had ceased the thermometer registered a lower mean daily temperature, the barometer continued to rise, and the wind retained the same northerly direction. In all three cases there was a disturbed electrical condition of the atmosphere: in the first instance a severe thunderstorm accompanied by heavy rain occurred on the day following; the second dust-wind was accompanied at its commencement by a little thunder and lightning, but by no rain; whilst during the two days preceding the third dust-wind there was a considerable amount of thunder and lightning, together with heavy rain.

From this comparison of the prevailing atmospheric conditions in connection with these dust-winds, a more probable explanation of their occurrence may be obtained, than that which is often proposed when simply assigning a "sudden breeze" and a "hot day" as the conditions required to give rise to them. H. B. GUPPY

17, Wood Lane, Falmouth, June 1

A Singular Cause of Shipwreck

THE strange loss of the *Phœnix* off the Iceland coast may perhaps lend some interest to the following:—

Last summer was the best the Icelanders had had for long past. I regret that I can give no thermometric readings, as my instrument became useless during the voyage. The weather in the north was nearly as warm as it has been here lately. All the snow-fed rivers were very full. The Jökulsà was nearly up to its high water-mark quite early in the season, and the Blanda was almost impassable. Icelanders who rode with me said that they had never seen the mountains from Hof's Jökul to Eyrik's Jökul so free from snow.

I append extracts from a letter which I have just received from one of my guides. A. J. HUBBARD

St. Thomas's Hospital, S.E., June 4

(*Verbatim copy*)

"Hjedinstrofda, April 16, 1881

". . . This winter has been so uncommonly strong that none such has existed this century. The frost has been extremely severe—32° R., once at Akureyri, and 36° R. (= $49\frac{1}{2}$° Fahr.) somewhere with Myvatn. . . . Ptarmigans and other birds froze to death. The farmers had spent most of their hay, and their cattle were to be killed or starve to death. All the sea was covered with ice, mostly polar ice, as far as one could see from the tops of the mountains. On the 2nd inst. the weather was mild, and on the 7th we had a real thaw, and every day since very mild and fine weather. But —— it is possible that the ice will not drive away before late in August, and no ship can come to any harbour on the northern coast; this happened in 1869.

"KRISTJÀN JÓNASARSON"

An Optical Illusion

THE optical illusion described in NATURE, vol. xxiv. p. 54, is, as I have already mentioned, referred to by Priestley (History, &c., Vision, Light, and Colours, vol. ii. p. 725). The description is as follows:—"M. Le Cat well explains a remarkable deception by which a person shall imagine an object to be on the opposite side of a board when it is not so, and also inverted and magnified. It is illustrated by Fig. 162, in which D represents the eye and C B a large black board pierced with a small hole. E is a large white board placed beyond it, and strongly illuminated, and *d* a pin or other small object held betwixt the eye and the first board. In these circumstances the pin shall be imagined to be at F on the other side of the board, where it will appear inverted and magnified, because what is in fact perceived is the shadow of the pin upon the retina; and the light that is stopped by the upper part of the pin, coming from the lower part of the enlightened board, and that which is stopped by the lower part coming from the upper part of the board, the shadow must necessarily be inverted with respect to the object." ("Traité des Sens," par M. Le Cat, Amsterdam, 1744, p. 298.) C. J. WOODWARD

Birmingham and Midland Institute, Birmingham, June 6

THE VISITATION OF THE ROYAL OBSERVATORY

THE Report of the Astronomer-Royal to the Board of Visitors on Saturday last at the annual visitation was listened to with special interest, and indeed the attendance of astronomers and others at the Observatory was very much larger than usual, because it was generally understood that this would be the last occasion of the kind on which the veteran astronomer would be seen at his post. We learn that an appropriate address was made to him by the Board of Visitors when he announced his attention of relinquishing his official duties in order to enable him to devote all his time and energies to the researches he has now on hand.

The astronomical observations, which occupy the first part of the Report, have been carried on with the usual diligence. Most of the routine work of the Observatory seems to have gone on in the usual fashion through the last year.

One of the objects of interest on this occasion was Halley's ancient tombstone, which, after its removal from Lee Churchyard (where it had been replaced by a new stone with a facsimile of the inscription), had been placed in the South Ground, where it had been lying for several years. It has now been carefully restored, and mounted on the east wall of the lobby of the North Dome.

The sun's chromosphere has been examined with the half-prism spectroscope on 29 days during the period to which this report refers. Fourteen sun-spots have been examined on 20 days, with reference to the broadening of the lines in their spectra. The results confirm the remark that some of the lines of iron are broadened in some spots, whilst others are broadened in other spots. Displacements of some of the lines of iron towards the red, and of others towards the blue, have also been noted in the case of one spot. A remarkable spectrum of a sun-spot showing 17 strong black lines or bands, each as broad as b_1, in the solar spectrum, was observed on November 27 and 29, 1880. These bands, to which there is nothing corresponding in the solar spectrum (except some very faint lines), have also been subsequently remarked in the spectra of several spots.

For the determination of motions of stars in the line of sight, 168 measures have been made of the displacement of the F line in the spectra of 43 stars, 87 of the b_1 line in 27 stars, and 8 of the b_4 line in 4 of these stars. Of these 70 stars 16 had not previously been examined, and the total number of stars of which the motions have been spectroscopically determined is now 91. In the case of 6 of the stars observed in the last year, a dispersive power equivalent to that given by 16 prisms of 60° has been used. Ten measures have been made of the relative displacement of the F and b lines in the spectra of the east and west limbs of Jupiter.

Comet 1810 *d* (Hartwig's), and the aurora of 1881, January 31, have been spectroscopically examined.

Between 1880, May 9, and 1881, May 13, photographs of the sun were taken on 140 days, and of these 284 have been selected for preservation. There are only 8 days out of 149 days on which the sun's disk was observed to be free from spots, whilst in the preceding year there was a complete absence of spots on 64 days out of 145.

The spectroscopic observations of all kinds have been completely reduced to 1881, May 6.

Touching the magnetical and meteorological instruments it was pointed out that the alterations of the photographic cylinders of the magnetical and meteorological instruments, which were in contemplation at the time of the last report, so as to make their time-scales the same in extent and in position on the record-sheets, have been to a great extent carried out. In the case of the declination and horizontal force magnets, two reflecting prisms with convex cylindrical front surfaces have been mounted by Mr. Simms above the registering cylinder, which has been lowered so that each prism receives the light from the magnet opposite to it. By this arrangement the traces of both magnets fall (as regards time-scale) on the same part of the sheet. The cylindrical lenses formerly used have been removed, being replaced by the cylindrical surface of the prism. The new arrangement is found to be perfectly satisfactory, and Mr. Simms is proceeding with a similar change in the case of the earth-current apparatus and of the vertical force and barometer registers.

A modification has been made in the system of determining the time-scales by the substitution of hourly breaks in the register, for the photographed hour-lines. The break at each hour is made automatically by a slight alteration in the apparatus hitherto used for registering the hour-lines. The time-scales for the declination, horizontal force, vertical force, barometer, and electrometer are now laid down in this way.

The unsatisfactory state of the earth-current register has been already noticed. After the change mentioned in a preceding section, it was soon found that the indications of the earth-current wires were disturbed by a continual series of petty fluctuations which almost completely masked the proper features of earth-currents. By cutting off the communications with those parts of the wires called the North Kent East Line and the Ladywell Line these disturbances were checked; but there remains a periodical disturbance at every hour, which entirely destroys the value and credit of the results. It seems not impossible that something may depend on imperfection of earth-communication. If this fault cannot be removed, the Astronomer-Royal proposes to return to the original system of independent wires (formerly to Croydon and Dartford).

The new pressure plate of Osler's anemometer has worked well. The limiting pressure of fifty pounds on the square foot was twice exceeded during the snow-storm of 1881, January 18.

The photographic records of the measures of magnetic earth-currents, in two directions upon the earth's surface nearly at right angles to each other, are maintained with the same regularity as those of the ordinary magnetic forces, and are preserved in readiness for reference or publication when need may require. An extensive confederacy is now organised, principally in Germany, for register of the earth-currents at several stations.

The following are the principal results for magnetic elements in the year 1880:—

Approximate mean westerly declination … … … … …	18° 32′
Mean horizontal force … …	3·912 (in English units). 1·804 (in metric units).
	° ′ ″
Mean dip .. … … … …	67 34 55 (by 9-inch needles). 67 35 53 (by 6-inch needles). 67 36 3 (by 3-inch needles).

The report proceeds:—

"In respect of diurnal inequalities of magnetic horizontal force and its direction, though all measures are ready, the curves are not yet actually formed. In the last report I adverted to the usual character of these curves. Assuming it to be certain that they originate from the sun's power, not immediately, but mediately through his action on the earth, it appears to me (as I suggested long ago) that they are the effects of the attraction of the red end or north end of the needle by the heated portions of our globe, especially by the heated sea, whose effect appears to predominate greatly over that of the land. I do not say that everything is thus made perfectly clear, but I think that the leading phenomena may be thus explained. And this is almost necessarily the way of beginning a science."

The number of hours of bright sunshine, recorded with Campbell's Sunshine Instrument, during 1880, was 1214, which is about the same as the average of the four years for which we have a record.

The discussion of the electrometer results for the year 1879 shows that the potential of the atmosphere is usually positive; that it is least in summer and greatest in winter, and especially in the colder weather of winter. There is also a definite diurnal inequality, having double maxima and minima, the maxima, on the average of the year, occurring at about 8h. a.m. and p.m. and the minima at about 3h. a.m. and p.m. In character the diurnal curve has a resemblance to the barometric curve, but the points of maxima and minima precede those of the barometric curve by about two hours. On days of magnetic disturbance, when aurora is visible, nothing unusual is remarked in the electrometer indications. Excepting thunderstorms the greatest disturbances are experienced in showery weather, and are probably local disturbances only.

The time work is thus referred to:—

"In the first few years after the strict and systematic examination of competitive chronometers, beginning with 1856, the accuracy of chronometers was greatly increased. For many years past it has been nearly stationary. I interpret this as showing that the effects of bad workmanship are almost eliminated, and that future improvement must be sought in change of some points of construction. One which occurs to me (I mention it principally as a specimen of departure from customary forms) is this. The impact of the escape-wheel upon the pallet of the balance-axis takes place very near to that axis, and must produce considerable friction, though of short duration. I proposed to the late Mr. Charles Frodsham to meet this by use of a broader pallet and a lighter impact of longer duration. The decease of that accomplished horologist prevented the completion of the trials which he had commenced for carrying out my suggestion. Other variations of the established form might be worthy of trial.

"The Greenwich time-ball has been regularly dropped automatically at 1h. on every day throughout the year, with the exception of 6 days when the violence of the wind made it imprudent to raise the ball, and 8 days when the severe frost of last winter prevented its being raised; and of one day when there was accidental failure.

"The Deal ball was not raised (on account of high wind) on 10 days. It was not dropped (through failure in the telegraphic connection) on 7 days, and was erroneously dropped about 5s. too soon by telegraph signals on one day; and on another day it was not dropped at 1h. owing to telegraph signals continuing up to 1h.; on one day the current was too weak to release the trigger. On every other day the ball has been dropped automatically at 1h.

"As regards the Westminster clock, its errors have been under 1s. on 31 per cent. of the days of observation, between 1s. and 2s. on 47 per cent., between 2s. and 3s. on 18 per cent., and between 3s. and 4s. on 4 per cent.

"The distribution of time-signals to all parts of the country continues to be made on the same system as in late years, by means of the chronopher at the central office of the Post Office telegraphs. In connection with this system, I would express the hope that the proposal to establish an hourly signal at the Start Point will be borne in mind.

"Last autumn a telegraphic determination of the longitude of Leiden was made with great care by M. M. Bakhuyzen. The interchange of signals between Greenwich and Leiden occupied nearly four months. I may here remark that the American extension of longitude carried out under Commander Green, U.S.N., to which reference was made in the last report, will be most useful for the transit of Venus in 1882. Cannot a British officer be found to complete the operations for Australia and New Zealand? I lament that this has not been done. Mr. Gill has undertaken the necessary work for the Cape."

The following important general remarks conclude the report:—

"The present meeting may afford a fitting opportunity for the expression of my views on the general objects of the Observatory, and on the duties which they impose on all who are actively concerned in its conduct. Assuming as beyond dispute that these ought to be carried out in a spirit liberal in itself and honourable to the nation, I proceed to state my opinion on the line of action which they suggest.

"The object prescribed to the Observatory is the promotion of "Astronomy and Navigation." And, since the abolition of the Board of Longitude, the second of these objects (which historically gave rise to the introduction of the first) presses upon the directors of the Observatory much more strongly than before. Considering then the claims of astronomy as bearing on navigation and our responsibilities in reference to them, we find that those responsibilities are by no means narrow. Whatever the rest of the scientific world may do or may not do, we are responsible for determinations of the fundamental elements of sidereal, solar, and especially lunar astronomy, with the highest accuracy that modern skill can secure. The same apparatus of instruments and of mathematical treatment which fix the places of fundamental stars will apply to those of other stars; the same which apply to the sun will apply to planets and comets (not unconnected with solar theory, by virtue of perturbation) and even to satellites. And we could hardly consider ourselves as discharging our duty to the more educated portion of the nation, or as maintaining our proper position in the world, if we did not include in our operations these latter offshoots of the first-mentioned objects.

"But new astronomical subjects have arisen of which no one dreamed when our constitution was first fixed. The first of these was the measures of double stars. But this, though important as ever, has almost disappeared from our view when occupied with solar and spectroscopic physics. I yield to no one in the interest which I take in these subjects, and in the admiration with which I regard the positive conclusions and the problematic suggestions which are founded on them. But I still point out that these are not parts of our original system, and their connection with the Greenwich Observatory is at any time liable to question.

"I now advert to the general subject of navigation. And first I remark that magnetism, in its ordinary and nautical form, is indisputably a proper subject for the Observatory. But within the present century there have arisen:—the accurate examination of magnetic irregularities, the partial reduction of daily irregularities to practical laws (still wanting theoretical explanation), and the establishment of the simultaneous co-existence of occasional disturbances covering the whole surface of the earth. Connected with these is the observation of magnetic currents through the terrestrial soil, registered at Greenwich for many years past, and now attracting attention on the Continent. Perhaps no branch of physics bears the same prospective importance as these. Yet I conceive that their continued study in this Observatory requires special authorisation.

"The original views in making astronomy contributory to navigation were limited to observations of the moon. But in the latter part of the last century the possibility of making chronometers subservient to the determination of longitude (a subject to which the late Board of Longitude gave good attention, and to which the Government has always offered liberal rewards) was proved, and in the present century the improvement has been very great. This has been effected by our Hydrographical Office (mainly through the action of the Observatory), partly by specific rewards, partly by careful attention to the accuracy of every chronometer purchased. And the practical value of the chronometric system has been very greatly increased by taking advantage of the galvanic distribution of time currents, and by the galvanic exhibition of ball-drops and other signals. There can be no doubt that all the agencies involved in this system are well employed, and that they are a legitimate part of the Observatory duty as originally contemplated.

"Still I remark that the Observatory operations bearing on chronometric navigation are not carried out to the extent which I could desire. It is known to all persons familiar with chronometers that rates of the chronometers, obtained while the ships are actually in voyage, would possess remarkable value. We possess the power of giving facility for obtaining these to a large part of our mercantile navy, by exhibiting a time-signal at every hour, at Deal (where the necessary apparatus already exists) and on the Start Point. I have several times brought this proposal, as regards the Start, before the Government, but unsuccessfully. But I should have done wrong if I had omitted, in this general survey of the duties of the Observatory, to state my continued conviction that this is a proper and very desirable addition to the other points of assistance which we can give to navigation.

"Next—closely connected however with the subject of navigation—is the knowledge of the longitudes of distant ports, as referred to the Greenwich Observatory. And I approach this subject with grief. We have entirely abandoned the longitudes of the Atlantic, which have been cleared away, before our eyes, by the scientific enterprise of another nation. The Pacific, bearing those vast and important colonies, almost entirely British, is equally neglected; though so much is ready that the mission of a single officer would quickly establish all. The same aspiring nation which has mastered the Atlantic is now bent (as I understand) on adding to its scientific dominion the Pacific. I think this is not honourable to our nation.

"There remains another subject, which occupies no small part of the force of the Observatory, and which I am unable to connect with either of the two great divisions to which I have alluded—the subject of meteorology. It is exceedingly popular in the country, perhaps because it requires little of expense or of science. It is also pursued at many foreign observatories, where vast numbers of observations are produced without attempt at classification or reduction. We at least are not amenable to this accusation, and may appeal to our reduction of more than twenty years' collected observations as giving matter of permanent interest to the more scientific meteorologist, and even to the geologist. Still I call attention to the fact that this is a subject which, though introduced mainly by myself, I regard as foreign to the original 'Astronomy and Navigation' of the Observatory.

"There is still a matter for consideration, not in our observations, but in the mechanism by which they are made available to the world—I mean our printing. I have repeatedly expressed my opinion that the extent of our printing is far too great: not in the full exhibition of reductions, but in the minute details of individual observations. There are printed every year more than 7000 transits or circle readings, each consisting of 6 or 7 individual readings, of which only the mean is useful. I do not believe that, since the year 1835 at least, any person in the world except ourselves has actually taken a mean. As each reading contains 3 or 4 figures, there are printed in each year something like 150,000 useless figures. Reliance must be placed somewhere on the skill and fidelity of the observer, and (considering the severity with which every figure of transit-wire and of circle-microscope, and of their means, is examined here) this reliance may be placed at least as well on the means as on the originals. I have reason to think that the bulky volume of nearly 900 pages, might be reduced to about three-fifths of its present size by omitting those originals.

"I would submit for the consideration of the Board whether it might not be advantageous that they should hold a special meeting to consider the subjects which I have indicated. The length of time at an ordinary visitation, and the circumstances under which the Board meets, are not sufficiently favourable for the discussion of broad questions of Observatory policy."

HOLTZ'S ELECTRICAL SHADOWS

IN an extremely elegant series of researches Prof. W. Holtz of Berlin has lately brought to light the existence of a new class of electrical phenomena, to which their distinguished discoverer has assigned the name of *Electric Shadow-figures.* Though nearly six months have elapsed since they were described in the Proceedings of the Göttingen *Gesellschaft der Wissenschaften*, no detailed account of them has appeared in any English journal. Yet the shadow-figures are remarkably easy to produce, and the whole research is of extreme simplicity, as very little apparatus is required beyond the simplest odds and ends to be found in every physical laboratory, the only large instrument necessary being one of Holtz's electrical machines.

The fundamental arrangement is that shown in Fig. 1. From the discharging-rods of a Holtz machine the brass balls are removed. To the left rod there is attached in place of the ball a circular disk of some 10 to 20 centimetres diameter, having its front face either flat or slightly concave. To the right rod a point is fixed, and it is drawn back till from 6 to 15 centimetres distant from the disk. A piece of silk or satin of the same size as the front surface of the disk is laid upon it while the machine is in action, it adheres of itself to the surface, and the preparation is now complete. Before the silk is placed over the disk a small "brush" discharge of blueish light is all that can be distinguished at the point of the right-hand discharging-rod: but this now changes to a very faintly glowing star. At the same moment the central region of the silk-covered disk exhibits a peculiar glimmering light over a well-defined circle. The utmost care is needed to shut out all extraneous light from the room, otherwise the delicate appearances which follow cannot be seen. It is upon this circular patch of feeble light that the shadow-figures are thrown. Its pale gleam becomes more vivid when the machine is more energetically worked: it enlarges in area but diminishes in brightness as the point is drawn back from it, and contracts with an accompanying increase in brightness as the point is brought nearer. It is possible to obtain a similar glimmering surface also upon a large metal ball covered with silk and attached to the rod in place of the concave disk, or instead a screen made of two or three folds of silk stretched over an ebonite ring may be placed between the two discharging-rods, the ends of both being furnished with points. In each case it is important that the silk be without crease or wrinkle, otherwise an evenly illuminated disk of light will not be obtained.

If now a body of definite outline of form be interposed between the point and the disk, an electrical shadow of it will be cast upon the luminous circle. These shadows are truly electrical, not optical, for all bodies do not cast them, and, more curious still, different bodies though of the same shape may cast differently shaped shadows. Conductors of electricity cast well-defined shadows, and so do semi-conductors, such as wood and cardboard. True insulators of small dimensions cast no shadows. The insulation or non-insulation of the conducting bodies makes no difference in their shadow-giving power. A cross cut out of cardboard casts (as in Fig. 1) a well-defined shadow at the centre of the field, but the exterior portions are somewhat hazy. An ebonite cross casts no shadow. A cross made up of two strips, one of cardboard, the other of ebonite, fastened with shellac, casts only a single bar of shadow. Rings of tinfoil, cardboard, or wire also cast shadows. Such small objects are conveniently held by attaching them to the end of glass rods. The size of the shadows increases if the objects are displaced from their central position to right or left. A strip of card or thin metal casts the same shadow whether it be held broadside or edgeways in the field. A wire grating having 5 millimetres width between the bars obscures the field like an opaque body. Breathing on a strip of ebonite or glass renders its surface a feeble conductor, and it casts a transient shadow. A glass rod heated at one point casts a shadow at the heated point, the shadow dying out as the rod cools. No shadow is cast by a conductor whose surface is completely covered by insulating material, such as a shellac-covered wire or a glass tube containing water, but dry externally. The smoke ascending from a cigar casts moving shadows upon the silken screen. If a small ball be fixed upon the left discharging-rod in place of the point the shadow on the silk is poor, but a second shadow is observed upon the surface of the ball, and this is excessively small, reminding one of the diminished erect virtual optical image in a small polished ball. This one experiment succeeds best if the ball be made the positive con-

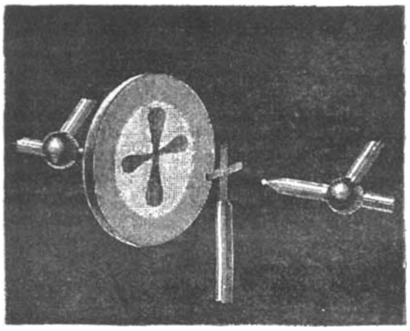

FIG. 1.—Electric shadow cast by a cardboard cross.

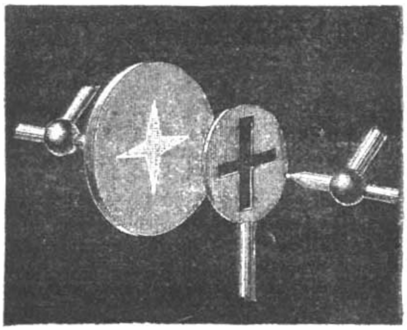

FIG. 2.— uminous figure projected through aperture in cardboard screen.